REMARKS

Claims 1-10 are pending in the present patent application. Claims 1-10 have been rejected. Claims 5-10 have been objected to under 37 CFR 1.75(c) as being of improper dependent form. The Office Action suggests rewriting claim 5 and claim 8 in independent form. Applicants have amended claim 5 and claim 8 in accordance with this suggestion. Marked-up and clean copies of claim 5 and claim 8 are included.

Claims 1 and 2 have been rejected under 35 U.S.C. 102(b) as being anticipated by U.S. Patent 5,690,731 to Kurata et al. The Office Action states that "...it is known in the art that for small rare-earth ions (e.g. Lu, Y), the rare earth oxyorthosilicates (e.g. Lu_2SiO_5, Y_2SiO_5) have a monoclinic C lattice structure...". The Office Action also states that "...rare-earth oxyorthosilicate crystal scintillators activated with Ce are also known in the art...". The Office Action also states that "...Kurata et al. disclose a crystal scintillator having the general formula R_2SiO_5 where R is at least one rare-earth element selected from the group consisting of La, Ce, Pr, Nd, Pm, Sm, Eu, Tb, Dy, Ho, Er, Tm, Yb, Lu, Y, and Sc (column 1, lines 6-9; column 4, lines 4-16)..". The Office Action also states that "...inherent in Kurata et al.'s disclosure is a transparent single crystal scintillator of cerium activated lutetium yttrium oxyorthosilicate having the formula $Lu_{(2-x-z)}Y_xCe_zSiO_5$ (i.e. R is the group consisting of Lu, Y, and Ce and thus $R_2 = Lu_{2-(x-z)}Y_xCe_z$ with $0.001 \leq z \leq 0.02$ and either $0.05 \leq x \leq 1.95$ or $0.2 \leq x \leq 1.8$)...". Applicants respectfully disagree.

Kurata et al. does not anticipate applicants claimed crystal scintillator because Kurata et al. does not disclose applicants' claimed composition, i.e. "...a crystal scintillator comprising a transparent single crystal of cerium-activated lutetium yttrium oxyorthosilicate having the general formula $Lu_{(2-x-z)}Y_xCe_zSiO_5$ with $0.001 \leq z \leq 0.02$ and either $0.05 \leq x \leq 1.95$ or $0.2 \leq x \leq 1.8$)...". The Kurata et al. patent is to a method of growing crystals. Kurata et al. use their method to grow crystals of cerium-doped gadolinium oxyorthosilicate (GSO), an already known material whose scintillation properties had already been demonstrated.

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Applicants provided an information disclosure statement with references to GSO, and LSO, YSO, and various mixed-metal oxyorthosilicate crystal scintillators. Kurata et al. states in column 4, lines 6-16, that "...The same effects as with the use of gadolinium oxyorthosilicate *would be obtained* with the use of another single crystal of a rare-earth silicate represented by the following general formula:

$$R_2SiO_5$$

wherein R represents at least one rare-earth element selected from the group consisting of La, Ce, Pr, Nd, Pm, Sm, Eu, Tb, Dy, Ho, Er, Tm, Yb, Lu, Y, and Sc, in view of the similarity in the mechanical properties of the crystals..." (emphasis added). While Kurata et al. states that any of these combinations form a crystal scintillator that can the place of GSO, one skilled in the art would know that many of these combinations cannot produce a crystal scintillator. Single crystals of a rare-earth silicate represented by the general formula R_2SiO_5 where R is only one rare earth, i.e. Pr_2SiO_5, Nd_2SiO_5, Pm_2SiO_5, Sm_2SiO_5, Eu_2SiO_5, Tb_2SiO_5, Dy_2SiO_5, Ho_2SiO_5, Er_2SiO_5, Tm_2SiO_5, Yb_2SiO_5, Lu_2SiO_5, Y_2SiO_5, Ce_2SiO_5, La_2SiO_5, and Sc_2SiO_5 cannot not produce crystal scintillators because they lack a doped activator.

While cerium-activated oxyorthosilicates Lu_2SiO_5 (LSO) and cerium-activated Y_2SiO_5 (YSO) are known crystal scintillators, Kurata et al. does not mention that they lose their scintillation properties when an excess concentration of activator is present. Kurata does not specify any concentration or range of concentrations for a metal/activator combination to produce crystal scintillators. Kurata et al. seems to suggest that any combination will produce a crystal scintillator. Applicants include a paper by D. W. Cooke, R. E. Muenchausen, B. L. Bennett, K. J. McClellan, and A. M. Portis entitled "Temperature-dependent Luminescence of Cerium-Doped Ytterbium Oxyorthosilicate," which describes the absorption and radioluminescence of $Yb_{1.999}Ce_{0.001}SiO_5$(YBSO), another combination that, according to Kurata et al., would replace GSO as a crystal scintillator. As the paper shows, YBSO is not a crystal scintillator. Applicants

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have also prepared single crystals of cerium doped Er_2SiO_5, another combination suggested by Kurata et al. that would replace GSO. This material also failed as a crystal scintillator. Clearly, the combination of a known activator with one of the metals suggested by Kurata et al. does not guarantee the production of a single crystal scintillator. The preparation of crystal scintillators comes about by trial and error; first, a crystal must be grown and only then can its scintillation properties be determined experimentally. There is no guarantee that any particular combination of elements can produce a solid solution of those elements and form a crystal, or that the crystal will be a crystal scintillator. Significant experimentation is required to produce new crystal scintillators.

The Office Action also states that the rare earth oxyorthosilicate lattice for both Y and Lu have a monoclinic C lattice (more particularly the C2/c monoclinic structure). However, the Office Action was silent on any reason why this type of lattice structure should guarantee a crystal scintillator. Both YBSO and cerium-doped Er_2SiO_5 also have the C2/c monoclinic structure, yet neither are crystal scintillators. In contrast, GSO does not have the C2/c monoclinic lattice structure but instead has the P21/c monoclinic structure. Yet, GSO is a scintillator. Meanwhile, both La_2SiO_5 and Ce_2SiO_5, which are suggested by Kurata et al. as crystal scintillators, should be isostructural with GSO and yet do not even form single crystals (see Brandle et al., Czochralski Growth of Rare-Earth Orthosilicates (Ln_2SiO_5), J. Crystal Growth, vol. 79, (1986)). Furthermore, although LSO and GSO have different crystal lattice structures, Loutts et al. (J. Crystal Growth, vol. 174, pp. 331-336) has successfully used the Czochralski technique to grow single crystals of cerium-doped mixed-metal oxyorthosilicate $(Lu_{1-x}Gd_x)SiO_5$ that that *are* crystal scintillators. These examples clearly demonstrate the shortcomings of attempting to use lattice structure to predict scintillation properties of oxyorthosilicate crystals.

Claims 3-4 were rejected under 35 U.S.C. 103(a) as being unpatentable over Kurata et al. in view of Loutts et al. and Melcher et al. Claims 3 and 4 are dependent from claim 2, which is dependent from claim 1 and so claims 3 and 4

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will rise or fall with claim 2. Applicants also disagree, as applicants have shown that Kurata et al. does not anticipate applicants claimed composition, i.e. Kurata et al. does not disclose a crystal scintillator comprising a transparent single crystal of cerium-activated lutetium yttrium oxyorthosilicate having the general formula $Lu_{(2-x-z)}Y_xCe_zSiO_5$ with $0.001 \leq z \leq 0.02$ and either $0.05 \leq x \leq 1.95$ or $0.2 \leq x \leq 1.8$, and Loutts et al. and Melcher et al. do not supply what is missing from Kurata et al. Loutts et al. and Melcher, in combination with Kurata et al., do not provide applicants' claimed composition or any properties thereof. The composition must first be made so that the properties can be measured.

The Office Action rejected claims 5-10 under 35 U.S.C. 103(a) as being unpatentable over Kurata et al. in view of Fitzpatrick (U.S. 5,500,147). The Office Action states that it would have been obvious to one having ordinary skill in the art that the scintillation detector of Kurata et al has a photodetector (e.g. photomultiplier tube or charge-coupled device) that is optically coupled to a crystal scintillator. Applicants respectfully disagree. Applicants have shown that Kurata et al. does not anticipate applicants claimed composition, and Fitzpatrick does not supply what is missing from Kurata et al. to provide applicants claimed composition, i.e. a transparent single crystal of cerium-activated lutetium yttrium oxyorthosilicate having the general formula $Lu_{(2-x-z)}Y_xCe_zSiO_5$ with $0.001 \leq z \leq 0.02$ and either $0.05 \leq x \leq 1.95$ or $0.2 \leq x \leq 1.8$.

In summary, many of the combinations suggested by Kurata et al. to replace GSO do not form crystal scintillators, and some do not even form single crystals. The preparation of crystal scintillators comes about by trial and error, where a crystal is first prepared so that its scintillation properties may be determined experimentally. There is no guarantee that any particular combination of elements can produce a crystal, and further that the crystal will be a crystal scintillator. Significant experimentation is required to produce new crystal scintillators. Applicants' claimed crystal scintillator having the chemical formula $Lu_{(2-x-z)}Y_xCe_zSiO_5$ (i.e. R is the group consisting of Lu, Y, and Ce and thus $R_2 = Lu_{2-(x-z)}Y_xCe_z$ with $0.001 \leq z \leq 0.02$ and either $0.05 \leq x \leq 1.95$ or $0.2 \leq x$

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≤ 1.8)…", is neither anticipated by nor inherent in Kurata et al., nor obvious in view of Kurata et al. in combination with any aforementioned reference.

For the reasons set forth above, applicants believe that all currently pending claims are in condition for allowance, and such action at an early date is earnestly solicited. No new matter has been added by the above changes. Reexamination and reconsideration are respectfully requested.

Respectfully submitted,

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